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MEMORANDUM

FROM: Deborah McKean, Ph.D.
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TO: Ted Lanzano
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SUBJECT: Qualitative Risk Assessment of Phase II ESA Data for Barnum Orchard at 101 King Street, Denver, Colorado

Introduction:
The purpose of this assessment is to assess laboratory analysis results for presence of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and Target Analyte List (TAL) metals in soil samples collected at the Site. This assessment evaluates the detected analytes thru a comparison to risk-based Regional Screening Levels (RSLs) for residential land use and literature data on anthropogenic levels of compounds found in the urban environment. The RSLs for soil are based on conservative exposure assumptions of a 30 year duration and 24 hours per day and include ingestion, inhalation and dermal exposure pathways. Although RSLs do not directly evaluate ingestion of fruits and vegetables grown in this soil, the conservative nature of the RSLs are thought to subsume the fruit and vegetable ingestion pathways. These comparisons will be the basis for the determination of suitability of this site as an urban garden.

Analytical Analysis Results.
The results highlighted in blue in the attached Table are those that exceed RSLs for residential land use.

VOCs
No exceedances of RSLs were observed in any of the soil samples.

SVOCs
Exceedances of residential RSLs were observed for several polycyclic aromatic hydrocarbons (PAHs) in several samples. Those PAHs exceeding residential RSLs include: benzo-a-anthracene, benzo-b-flouranthene, benzo-a-pyrene, and dibenzo(a,h)anthracene. It should be noted that PAHs, are often found at elevated levels in urban environments. Although exceedances are noted, the levels detected do not result in exposures and risk above EPA's target risk range. PAHs are found products of incomplete combustion of gasoline, oil, and coal, in asphalt, and as a result of forest fires. PAHs bind very tightly to soil and are not taken up into plant material.

Pesticides

No exceedances of RSLs were observed in any of the soil samples.

TAL Metals
Arsenic and thallium were found to exceed residential RSLs in a number of soil samples. Although exceeding residential RSLs, arsenic and thallium levels detected are within the range of concentrations typically found in the Denver area as reported by the United States Geological Society (http://pubs.usgs.gov/of/2014/1082/pdf/ofr2014-1082/pdf).

Conclusion:
Soil concentrations of PAHs, arsenic and thallium found to exceed residential RSL but are within the range of concentrations typically found in the Denver area. Although risk from direct exposure to soil is minimal compared with other Denver urban soils, it is recommended that soils are amended to lessen the levels of PAHs, arsenic and thallium that have been detected. Therefore, the following recommendations may be considered when developing and maintaining gardening areas:

- Amend soil with compost and/or commercial topsoil and adjust pH for optimal growing conditions. Amendment for most gardening areas to one foot is sufficient for plants with shallow root systems. Raised beds using non-site soils can also be considered. Amendment to greater depths over larger areas will be helpful in areas intended for fruit trees since root systems will extend to areas equal to the tree canopy upon tree maturity.

- Cover soil and walkways not used for growing purposes with mulch, geotextiles, or gravel.

- Use Best Management Practices to limit exposure to bare soil, such as those listed in http://epa.gov/brownfields/urbanag/pdf/bf_ruban_ag/pdf.